THE JOHNSON

HEAT REGULATING APPARATUS

IN SCHOOLS.

FOR SALE BY

NATIONAL ELECTRIC SERVICE CO.,

120 BROADWAY, NEW YORK.

(EQUITABLE BUILDING.)

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BURDICK & ARMITAGE, PRINTERS, MILWAUKEE.

PATENTS.

The Johnson Heat Regulating Apparatus is fully covered by letters patent in the United States and in Foreign Countries.

THE JOHNSON

System of Heat Regulation in Schools.

DEFECTS IN HEATING APPARATUS.

The inventor of this system of temperature regulation was for many years connected with institutions of learning, and having been a large part of the time in the department of Natural Sciences, was in a position to be well informed regarding the systems of heating used in buildings designed for school purposes. From his observations of the great inconveniences, discomforts, and unhealthfulness of the variable and unequal temperatures to which the occupants are subjected, his attention was called to some method by which the temperature and ventilation of school buildings might be kept at a proper degree, automatically, thus securing a proper degree of heat and ventilation, and also relieving the instructors of the attention which an attempt at regulation necessarily requires. In no other buildings are the defects of heating and ventilating so pernicious as in school buildings, for the reason that in no other buildings are the rooms so constantly occupied by a large number of people for such long periods of time. In private buildings the number of occupants per room is so small, that, although poorly ventilated, there is usually a comparatively large amount of breathing room for each individual. In churches and halls, while the auditoriums are overcrowded during the sessions, yet such buildings are seldom occupied upwards of two hours at a time, and the same people do not, day after day, congregate in the same places. The effects, therefore, are not as marked, as the people in attendance are only subject to the unhealthful conditions for a short period of time and at remote intervals. In schools, however, the case is entirely different; for six hours in a day, and for five days in the week, the same individuals are subjected to the same abnormal atmospheric conditions, and what makes the matter still worse is that the pupils are in a state of growth and development, and are therefore much more sensitive in their organisms, and more liable to be affected by the variableness of the temperature and the unwholesomeness of the air which they breathe. Since stoves have gone out of use in school buildings, there has been a gradual improvement in the matter of ventilation of such buildings, especially in the larger towns and cities. A stove in a school room is absolutely the worst form of heating which could be devised for an apartment which is to be occupied by a body of children. It simply furnishes heat (and often overheat), but does not give any possible change of atmosphere of the room. The only means of obtaining a change of air is by opening the windows, and this is seldom done by teachers, excepting to get rid of the surplus heat, rather than in view of proper ventilation. As a remedy for poor ventilation, the opening of the windows is almost as bad as the disease, and it subjects the occupants of the room to drafts of air and certain variations of temperature which are almost sure to result in catarrhs. The introduction of what is called the hot air furnace, placed in the basement of school buildings, marked a long advance in the methods of heating school-rooms, for the reason that there must be some degree of ventilation in order to warm the room, as it is well known that no warm air can enter the room unless there is some escape for the foul air, for which provision must be made. This method of heating, however, does not have the effect to give the proper temperature, for as one furnace usually supplies the heat to several apartments, either one or more of the apartments is liable to be overheated, in order to properly heat some other. When a room is overheated, the teacher has recourse to either open the window or close the register, at the same time exercising his discretion in performing both operations, thus shutting off the ingress of pure warm air and retarding ventilation. It is evident

from this mode of controlling ventilation, that even a hot air furnace will not supply proper ventilation and heating. Where steam furnaces are used for heating school buildings, they may be as bad as stoves or as good as a hot air furnace, depending upon the system adopted. In some buildings we find all the heating done by steam coils, which are placed in the rooms to be heated. These coils, therefore, act simply as stoves, and do not effect any change of atmosphere in the rooms. In modern buildings, however, the greater amount of heating is placed in the basement, and air from the outside passes over the steam pipes and enters the rooms from registers, the same as in hot-air heating. With this appliance, of course the steam heater acts the same as a hot air furnace in supplying the warm air, and also, like the air furnace, has the defect of being shut off from the room by the closing of the register when the room becomes overheated. It is seen from this, that whatever system of heating may be adopted, unless there is an adequate provision for the regulation of such heating device, there will be a deficiency of ventilation in proportion as there is a surplus of heat. With the variable climate we have in the United States, all heating devices must have power enough to keep the rooms at the desired temperature during the coldest days ; but such days are comparatively rare, and therefore during the remainder of the time the heating apparatus has a capacity too great for its use, and with the utmost care will overheat the rooms. It may be said that the school-rooms of the United States are overheated nine-tenths of the time. The inventor of this apparatus, having from experience and observation a knowledge of these facts, undertook, by some method, to automatically control the heating and ventilating devices. The result of his experiments has been the JOHNSON SYSTEM OF TEMPERATURE REGULATION, which is adapted to automatically control the heating and ventilating of all school-rooms of whatever size, and to perfectly manage, without intervention of teachers or janitor, the heating device used in the building, whether such device be hot-air furnace or steam boiler.

HEAT CONTROLLING APPARATUS.

Attempts have been made for upwards of thirty years to regulate heating apparatus, but in all such devices as have been heretofore used there has been a lack of power, or the power has been improperly applied, or the device was not adapted to all conditions. Most apparatuses which have been made have used electricity directly to open or close the valves, or have used electricity to control clock work which opens and closes the valves by means of a spring or weight. In this method of operating valves, it is evident that the battery power used needs be so great in operating valves of any practical size that the apparatus will be both cumbersome and expensive. Where clock work has been used, difficulty arises from lack of power, and in order to get sufficient power, the apparatus would need to be very large and expensive, and beside would need close attention to keep the clock work wound up. It also happens that the valves must necessarily be in inaccessible places, so that any form of clock work would be hard to get at to wind it. This new invention, however, avoids all these difficulties by doing away with the positive mechanical motors, or by valves to be operated by electricity alone, and employs a form of power much more adaptable to all cases, a mechanism which requires but little space, and has a power as great as may be needed in any particular case. The essential elements of force in the Johnson Heat Regulating Apparatus are electricity and fluid pressure. Electricity acts to control the fluid pressure, and fluid pressure acts directly to operate the valves. Any one with any reading upon the subject whatever knows that fluid pressure varies in power in proportion of the area of the surface to which the pressure is applied. Thus, if there is an area of one square inch upon which the force of the fluid pressure is applied with a power of ten pounds, if we apply the same fluid pressure to an area of ten square inches, we will get a power of one hundred pounds, and as the area to which we apply the fluid pressure may be increased to a large extent, it is evident that with a fluid pressure of only a low power per square inch we can get an enormous power to move such mechanism as we desire to use in operating the valves. In this device an air pressure of ten pounds per square inch is all that is ever used. It will be seen that with an area of seventy-eight square inches (that is, the area of a circle ten inches in diameter), we get a total pressure of *seven hundred and eighty pounds*, which is sufficient to move any valve ordinarily used in heating. We will not at present fully

describe this apparatus, but we do so farther along. It will probably occur to most people reading this that the apparatus is complicated and would take up much room, etc.; but such is not the case. It is unobtrusive, and a person visiting the school-room where it is applied would not notice that there was anything different in the room than usual.

HOW APPLIED TO SCHOOL ROOMS.

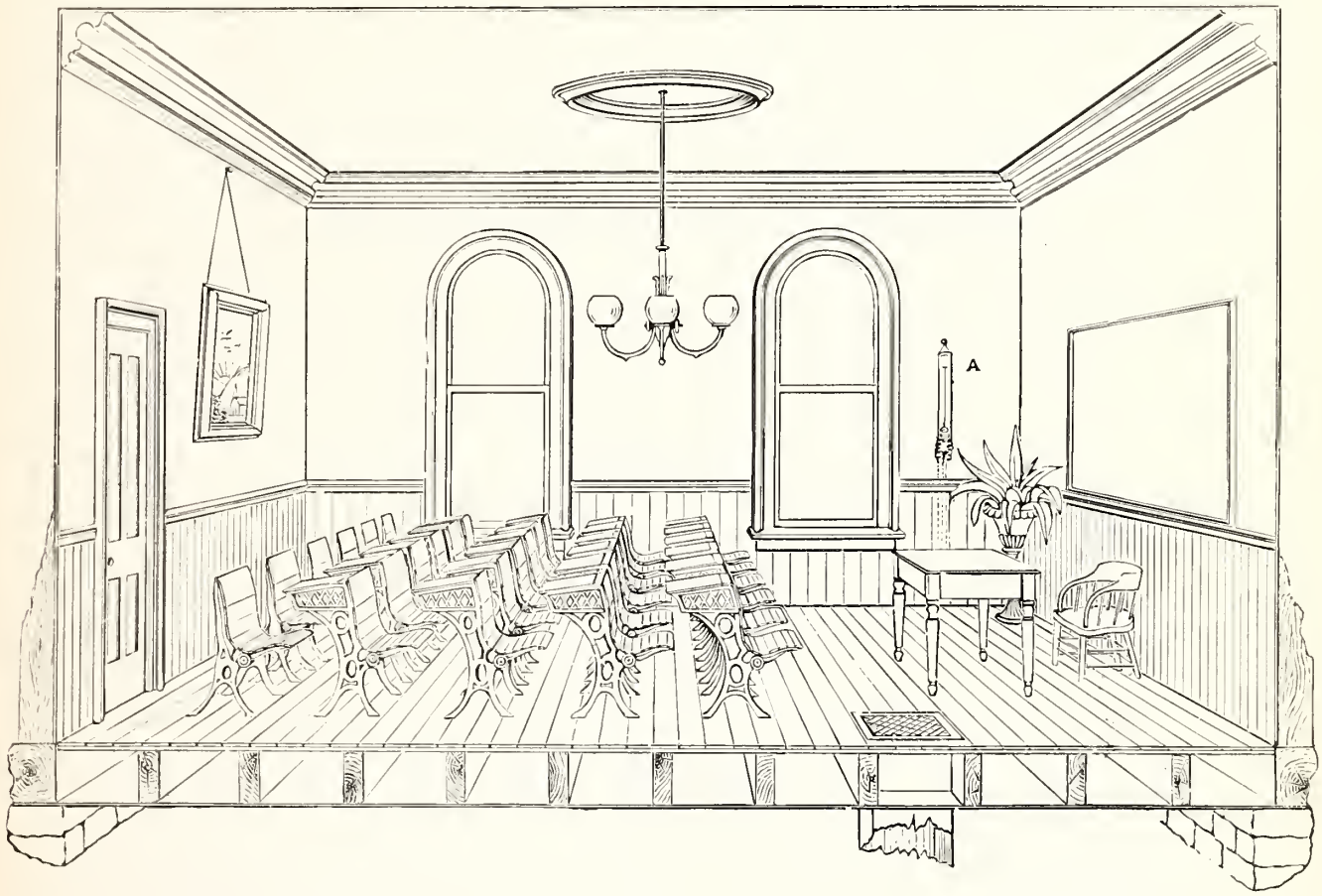

Fig. 1.

Fig. 1 shows a part of school-room in which the apparatus is applied. Upon the wall, or some support in the room, is a thermostat A, which is connected electrically with the apparatus which warms the room. As usual in heating, the heat may all pass through a register into the room, or it may pass partly through a register and partly through steam coils. The only thing which appears in the room aside from the thermometer are the valves upon the steam coils, (if there are any in the room); otherwise the thermometer, or *thermostat*, as it is more properly called, is the only part of the device which is in the room. By a screw placed upon the thermostat it may be adjusted to any degree of temperature which is desired. Thermostats are usually set at 70 degrees Fahrenheit, and for school-rooms it is thought that no higher degree of heat should be used, whatever the notions of the teachers may be in that particular. From the the thermometer some electric wires, which are concealed behind the woodwork or plaster, go to the basement, where the rest of the apparatus is situated, as is shown in fig. 2.

These figures of course do not represent the apparatus as actually located in every building, but are placed in the cut so as to give the best idea of their relations to one another. The wires from the thermostat A, in fig. 1, pass to a small electrically actuated air valve B, and also to the battery C, which is placed in the base-

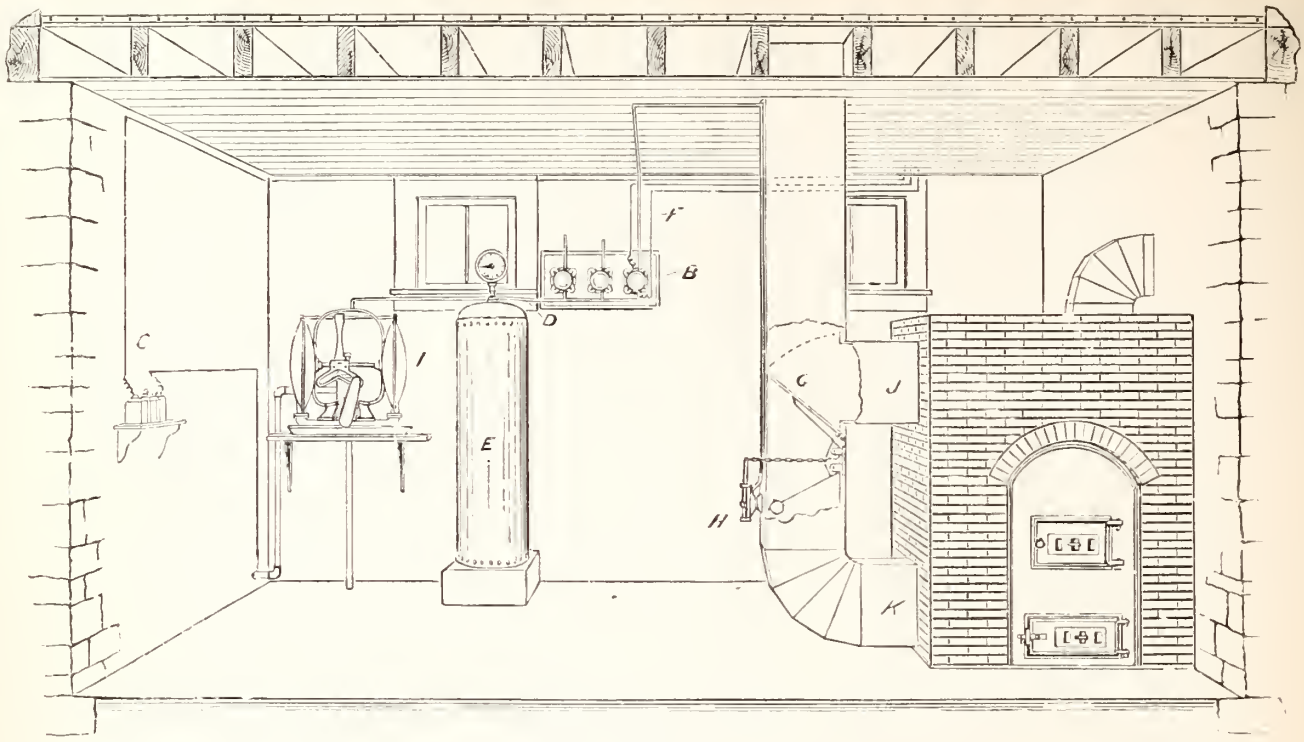

Fig. 2.

ment. This battery is of the same style as is used with telephones, and requires no attention from the occupants of the building oftener than once in a year or two. A pipe D leads from this small electric air valve to the cylinder E, containing compressed air; and from the valve B another pipe F leads to the register or valve which is to be operated by the compressed air; the valve, or the register F, as the case may be, has an expansion chamber H attached to it, which, when inflated by the compressed air, pushes upon the valve and shuts it, and which, when the compressed air has escaped, allows the register or valve to open again by a spring. The thermostat acts in this way: When the room is as warm as desired, the thermostat closes the electric circuit and thus operates the little valve B, and allows the compressed air to pass from the cylinder E to the expansible chamber H, which operates the damper G and closes it, thus shutting off the heat. When the heat is shut off, of course the room begins to cool, but when it has cooled about one or two degrees, the thermostat makes an electric circuit, which turns the little valve B in the opposite direction, and shuts off the supply of compressed air, and allows the air which was in the expansible chamber H to escape into the open air, thus allowing the register or valve to open. The room will begin to get warm again, but cannot go beyond the point at which it was stopped the previous time, as at the same point the register or valve will be shut again. Thus the valves will be open and shut alternately in short periods of time, keeping the temperature of the room constantly at the same point so long as the supply of heat is maintained by the proper amount of fire.

The compressed air in the cylinder E is furnished by an automatic air compressor I, which is operated by the water pressure in the building. By this method of compressing air there is no attention to be paid to the compressing of the air, for the pump automatically maintains the pressure of ten pounds per square inch, or such other pressure as is desired. In school buildings where there is no water pressure, we supply a hand pump for compressing the air, the work being done by the janitor two or three times a day, as it is needed, requiring two or three minutes of his time at each compression. The greatest amount of time required to compress the air is not greater than ten or fifteen minutes per day. So it is seen that where there is no water pressure to compress the air, that the compression of it by hand is a very simple matter.

Having described the apparatus in general, we will proceed to show different methods of attachment to the heating of the building.

In Fig. 2 is shown a section of the hot-air furnace to which our apparatus is applied to regulate the temperature and ventilation of a building. The section given shows a furnace manufactured by the Ruttan Manufacturing Company of Chicago, which is used largely, and to which we have made the attachment of our heat regulating apparatus in many buildings.

This furnace is designed to furnish a large amount of pure warm air to each room, the furnace and the flues having a capacity to provide 2,000 cubic feet of air per hour for each pupil. In showing this furnace, we will have an opportunity of illustrating how our apparatus is applied to a building where the heating is all indirect; that is, by means of air heated in the basement, and which arises through the flues into each room. Where steam heating is used the device is somewhat similar, but does not illustrate the apparatus as well as this one, and unless a forced supply of air is passed through the coils by means of a fan, there is usually less perfect ventilation in the room.

The valve G is placed in a flue in such a way that when it is in the position shown in the cut, it allows the warm air from the pipe J to pass freely into the room. When, however, the damper G is raised by the compressed air to a vertical position it shuts off the hot air, and allows the cool air which comes in through the pipe K to ascend freely into the room.

It will be seen from the above description that, while the thermostat has a positive control of the heating of the room, it does not retard the ventilation, as the room is never shut off from the supply of air, warm or cool, either one or the other. Our apparatus has been used with this attachment so far in several buildings, and with most excellent satisfaction. Besides operating the valves which control the heating of the room, we also make an attachment to the drafts of the furnace itself, so that the fires will be controlled in proportion as heat is needed. It is evident that where the attachment is made only to the dampers, or valves which control the heating of each separate room, that although the rooms cannot be overheated, yet the fires will not be checked unless attended to by the engineer or janitor. It is therefore highly important, both as a matter of economy and safety, to control the fires as well as the heating of the rooms. Where applied to the drafts of the furnace, a diaphragm mechanism is shown in

HOW FUEL IS SAVED.

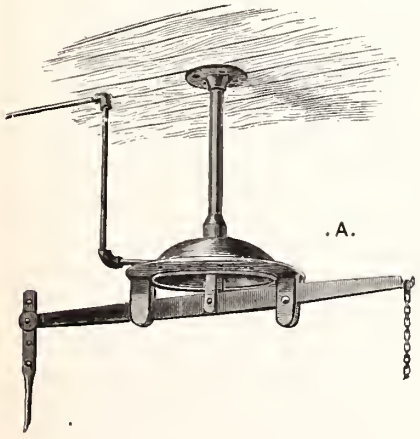

Fig. 3.

Fig. 3, which is easy to operate so that the drafts of the furnace will be either checked or opened, as there is necessity for heat in the rooms. We do not deem it important or expedient to show the whole of the apparatus here, but it is sufficient to say that it operates in this wise: Let us suppose that four rooms are heated by the same furnace; the draft regulating apparatus is so attached that when all four rooms are sufficiently warm, and the heat shut off, that the diaphragm mechanism will operate the furnace so as to check the fire. This prevents the furnace overheating, and also the waste of fuel when it is not needed. It is very easy to be seen that during mild weather the heat will be shut off from the rooms a great proportion of the time, and consequently the drafts of the furnace will be checked a correspondingly large part of the time, and thus the furnace will keep up a very slow and mild heat.

This draft mechanism is also arranged so that when *either* one of the thermostats opens the register or valve for that room, that the drafts of the furnace will also open and start the fire. This prevents any one room getting too cool when others may be warm enough, and also prevents the fire getting so low as not to start readily when heat is needed. When, however, *all the valves* are closed because the rooms are warm, *the*

drafts of the furnace will also close, and thus check the fire. This makes the furnace perfectly automatic in regard to the amount of heat furnished, and that not a pound of fuel can be wasted, since the furnace drafts respond perfectly to the need of heat.

We wish to call particular attention to the effect that our apparatus has on the distribution of the heat throughout the building. Any one who has had any experience either in heating buildings, or in using buildings which are heated by warm air, knows that it is utterly impossible to so arrange the heating apparatus or the size of the flues as to give at all times and under all circumstances the proportional amount of heat to each room. As an illustration, let us take four rooms of a school building, and let these rooms represent one floor of the building, one room being in each corner. Now, it is evident that when the wind is in the northeast the room in that corner of the building will not be heated as well as the one in the southwest corner, because the tendency of the atmosphere outside the building is to throw the air in the building *toward the direction in which the wind is going*. In this case, the northeast corner room will either not be heated enough, or the southwest corner room will be heated too much. With a constant variation of wind from day to day, there is a constant and corresponding deflection of the air circuits within the building itself, so that it becomes utterly impossible to equally distribute the heat. THE JOHNSON HEAT APPARATUS entirely remedies this defect, and it is one of its most important and greatest advantages. To show how this is so we will illustrate it by four rooms. As said above, if the wind is in the northeast, the southwest room will get warm first; but as the thermostat shuts the heat off from that room at the proper degree of temperature, all the air from the furnace will be forced into the other three rooms. This being so, the southeast and northwest corner rooms will next become sufficiently heated; and in like manner the thermostats in these two rooms will shut off the heat from them, as in the case of the southwest corner room. Now, since three of the rooms are shut off from the furnace, all the air from the furnace will be forced to enter the northeast room *against its natural direction*. This will bring the last room to a proper degree of heat, and during the day it is easily understood that for a larger portion of the time the other rooms will be shut off, and the heat for the greater portion of the time be thrown into this one room. This gives an absolutely equal distribution of the heat of itself, which can be attained in *no other way and by no other means*.

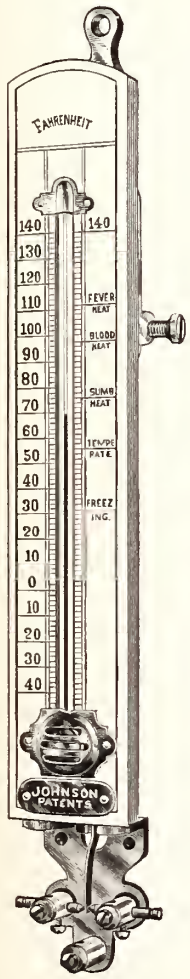

Fig. 4.

PARTS OF THE APPARATUS.

Fig. 4 is a view of the thermostat, which is placed on the wall of the room. To a casual observer it is a thermometer only, having a fine mercury column and plain figures upon its ace. We would say, however, that the thermometer nor the mercury have anything to do with the device. The electric circuits are made by means of expansion and contraction of a bar which is fastened near the top behind the thermometer, and whose lower end, by means of a tongue (seen in the cut near the bottom), is free to move from right to left and make electric circuits, first with one and then the other point. The wires from the thermostat lead from the three binding posts, seen at the bottom, to the small electro-pneumatic valve which has previously been spoken of, and which is usually located in the basement. The working parts of the thermostat are very durable, and cannot get out of order unless very rudely tampered with. In some cases we cover them up with guards, to prevent children and others from meddling with them.

When it is desired to adjust the thermostat to any desired temperature, it is done by turning the screw A, on the side of the thermostat, as shown in the cut. This, however, does not need to be done excepting at long periods of time, and the most that we ask for the thermostat, as with most other parts of the apparatus, is that

it be let alone. In the drawing the thermometer is seen to be at 70, and that is the point at which the thermostat should be set in the school-room; never higher than that, at least.

Fig. 5 shows the electro-pneumatic valve which is operated by the thermostat. This is placed usually in the basement. All the working parts of it are concealed within the casing, and are very durable, and in such a position that they can never be injured by either children or dust. The four spools shown in the drawing are wound with electric wire that produces the magnetism to operate the valve. The electric wires are attached to the binding posts on the base, one of which posts only is seen in the cut. The battery needs no particular description, as it is one of the ordinary sorts used with the telephone and to ring electric bells. There are probably not less than 1,000,000 of these in use in the United States at the present time. They require very little attention. We place the battery in the basement, as shown in fig. 2, and generally use about four cells.

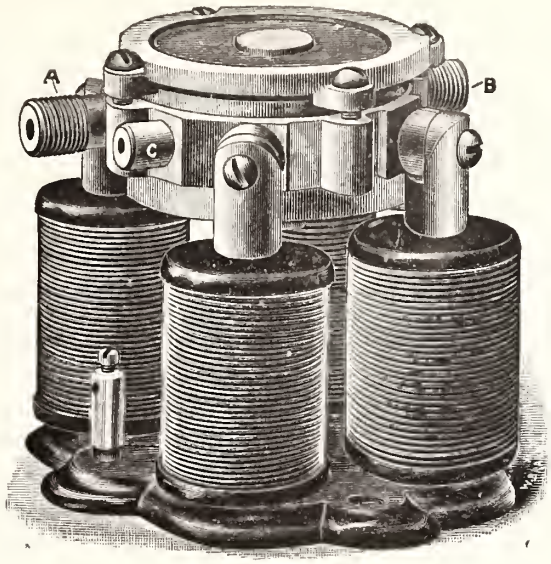

Fig. 5.

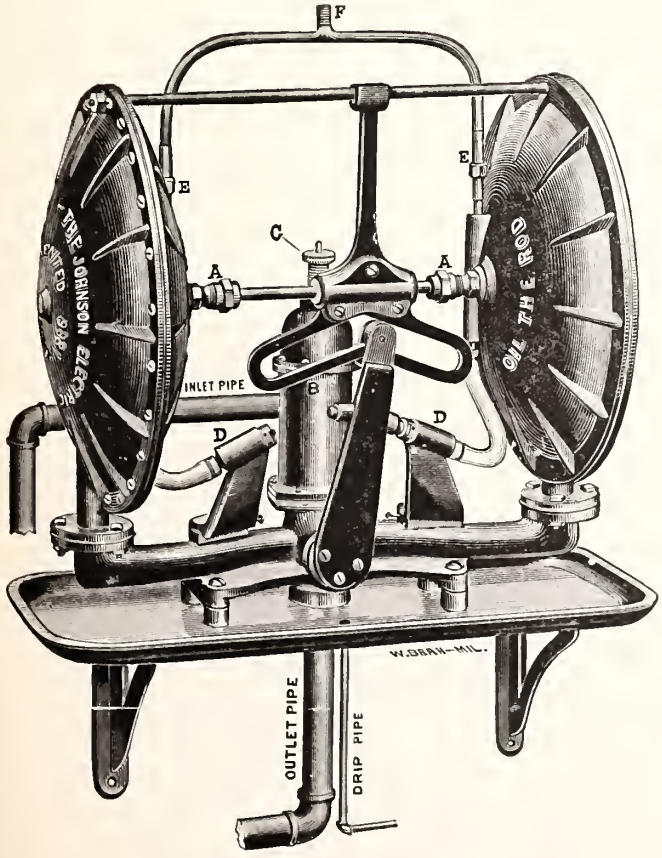

Fig. 6.

Fig. 6 shows an automatic air compressor. This compressor is applied to the water supply of the building, and keeps the air cylinder full of compressed air without any attention from any one. It will run for months, night and day, without looking after, except to put a little oil upon it once in a while.

We would say that the air compressor does not run continuously and thereby waste water, but only moves as the supply of air is exhausted. If no air is used the air compressor does not work, but as soon as any of the air is used, it works just long enough to make up the loss. Thus very little water is used to keep a pressure of air; so little in fact that the waterworks departments seldom make any charge for the water used. When there is no water system used in the building we use a hand pump.

Where there are a great many rooms to be controlled, and there is no water system, we use a larger hand pump, which is turned by a crank.

The valve operating mechanism differs very much, depending upon the size. On steam pipes we use a valve which is similar in most respects to an ordinary valve, but has on it a chamber through which the compressed air pushes the valve shut.

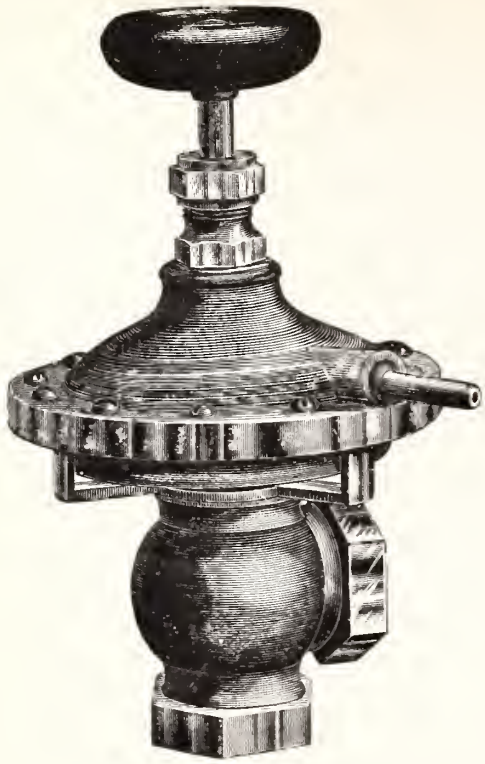

Fig. 7.

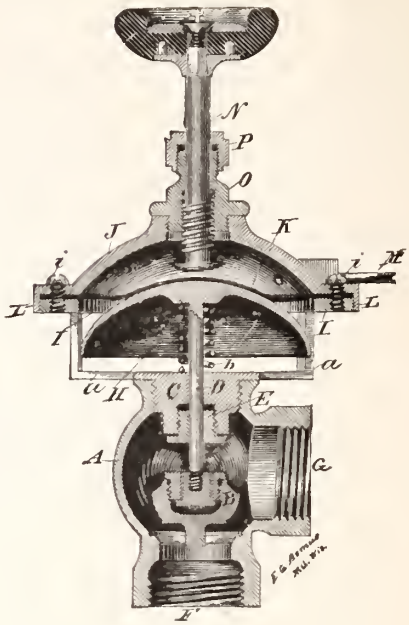

Fig. 8.

Fig. 7 shows the outside of one of these valves, which is adapted to be put upon a steam radiator.

Fig. 8 is a sectional view of this same valve, showing how it operates.

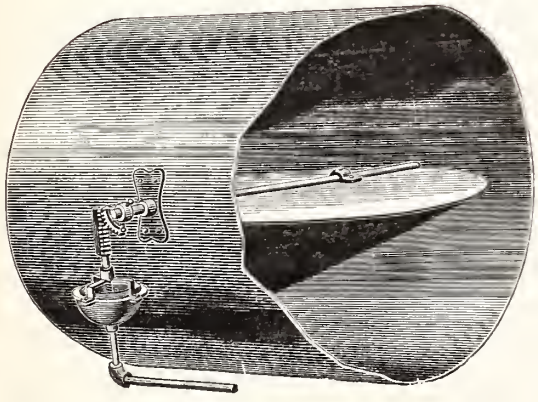

Fig. 11.

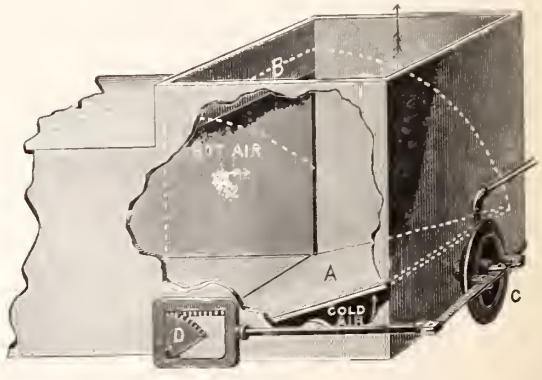

Fig. 12.

Fig. 11 is a butterfly damper put in a hot air flue, and may be made of any size required.

Fig. 12 is a square valve to be put in the angle of a square pipe or flue to shut off the warm air and allow cool air to enter the room, and when the room cools a little to reverse and allow the hot air to again enter.

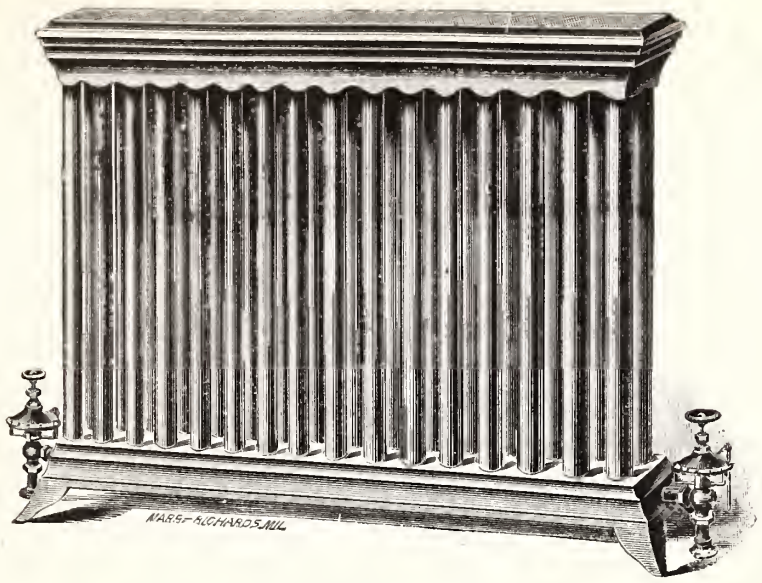

Fig. 9.

Fig. 9 shows a radiator with electric valves attached. These valves shown in fig. 10 are at either end of the steam coil.

Fig. 10 shows a globe valve, which is similar in its mechanism, but is made to be placed on a straight pipe instead of an angle. These valves are shown in fig. 9, at either end of the steam coil. It will be seen that they occupy but a small space, and are not large and ungainly. The valve shuts with a piston motion, and is held to its seat with a cushion of air having a pressure of from 50 to 300 pounds, according as the case demands. For this reason the electric valve never grinds or destroys its seat. It makes no difference how much the stem or other parts may shrink in cooling, the valve is just as firmly seated, for the elastic pressure will take every advantage of the shrinkage to seat the valve closer. When the electric valves are applied to a system of heating, they are always all open when the steam is down. There is no need of going about a building to see to them, for the pipes are all free, and no water can collect to freeze. When the fires are started the steam passes freely to all parts of the system. Not only does the valve shut steam off from rooms that are warm enough, but since it shuts off the radiating surface that is not needed, the pressure rises accordingly, and distributes the heat to rooms which are not yet warm enough, thus acting as an equalizer. With the electric valve it is possible to keep up a sufficient pressure to warm the coldest room in the building without the least overheating any other room. For this reason alone the electric valve is worth ten times its cost. Figure 7 shows the diaphragm applied to an angle valve; but we make all other forms of valves, such as globe (fig. 10), gate, butterfly, etc., and each works equally well. For indirect radiation we apply the valves directly to coils which heat the air, to the cold air box which supplies the air, or to the register.

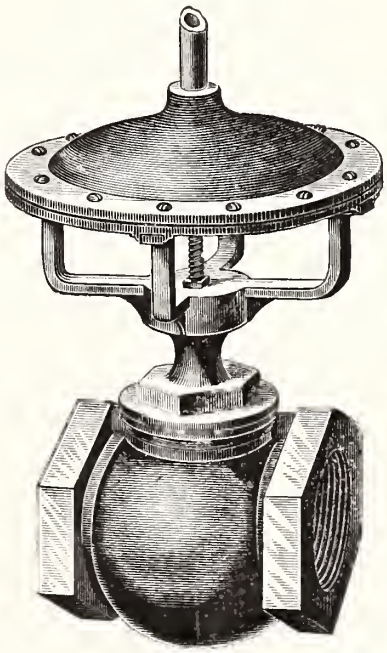

Fig. 10.

FACTS AND OPINIONS.

MILWAUKEE SCHOOLS.

Recent investigations show a saving of 15 per cent. in fuel used in the public schools of Milwaukee during the winter of 1885–6, where our Heat Regulating Apparatus has been applied. From official records in the office of the Secretary of the School Board, complete with reports from Principals named below, the following data have been obtained:

COAL USED DURING THE WINTER OF 1885-86.

Name of School.	Cubic Contents.	Tons of Coal Used.	Space per Ton.	Average Space per Ton.	Remarks.
1st District, - -	258,000 Cubic feet.	132	1954	1957	Without our Apparatus.
12th District, - -	300,000 "	153	1960		
9th District, - -	372,000 Cubic feet.	167	2227	2247	With our Apparatus.
10th District, - -	346,000 "	152	2261		

This shows a saving of 14.6 per cent. of fuel in the 9th and 10th District Schools. Our Apparatus was placed on the heating for school rooms only; had it been placed on heaters in cloak rooms and corridors the saving would have been much more.

The style of heating in these four buildings is the same; the boilers are all of the same pattern, and the radiation and its distribution being alike in every particular.

The above facts, in connection with the uniform, healthful temperature secured by our Apparatus, have led to its adoption by the Board of Public Works for all school buildings, new and old, for which heating apparatus has to be supplied.

We are pleased to furnish the following communication from the BOARD OF PUBLIC WORKS of the city of Milwaukee, and the SUPERINTENDENT OF SCHOOLS of that city:

OFFICE OF THE BOARD OF PUBLIC WORKS,
MILWAUKEE, August 10th, 1886.

GENTLEMEN:

We take pleasure in saying that your Heat Regulating Apparatus, placed in four of our public school buildings, has given entire satisfaction, regulating the temperature as guaranteed, thus saving fuel and attention.

As applied to our schools, all direct radiation for one room being placed in one coil (instead of six or eight, as usual where heat has to be regulated in the ordinary way), we have found that the original cost of the heating plant has been increased but very little, and we heartily recommend its use in all school buildings where large numbers of children are necessarily confined the greater part of school hours.

C. P. FOOTE,
W. P. O'CONNOR,
GEO. P. TRAEUMER,
Commissioners of Public Works.

Oefice of the School Board,
Cor. Seventh and Prairie Sts.,
Milwaukee, August 12, 1886.

Dear Sirs:

It affords me great satisfaction to state, in regard to the efficiency of your Heat Regulating Apparatus, that our experience with the improvements supplied last winter to the 8th, 9th, 10th and 12th district primary schools has thoroughly convinced us of the truth of the following facts:

First. Your apparatus *is* automatic, and maintains an equable temperature, never higher than that required, and only lower as the fire burns out or down. This seems a very simple result in the problem of heating, but not till we had made a practical test of this modern device did we realize the great luxury to be enjoyed, and the great increase of comfort which is the accompaniment of this one simple fact.

Second. We have pretty good evidence to show that your apparatus saved a considerable part of its cost in the saving it effected in fuel. Similar schools, two containing the Regulator and two not, have been visited and account of coal consumed has been compared. The difference is so marked that we can hardly find any other explanation than that the Electric Service has effected a saving of about 15 per cent.

Third. We find a great advantage and merit in your Apparatus over the clumsy and less modern contrivance, called the janitor. Always prompt and true and sensible, it quite relieves the school of that average bustling appendage during school hours. In short, I cannot recommend your contrivance too highly. It is the one essential to thoroughly reliable heating apparatus. Without it the apparatus is not modern, is deficient in the most important improvement that has ever been added to heating devices in one invention.

Yours truly,

W. E. ANDERSON,
Supt. of Public Schools.

High School, Milwaukee, Wis.,
April 29, 1887.

Gentlemen: I am much pleased with the operation of your heat regulating apparatus which is applied throughout this building. The temperature of every room, hall and corridor is regulated thereby to a definite standard, and not by the personal peculiarity of the teachers, some of whom would otherwise be satisfied with a temperature much lower or much higher than what is normal and healthful for our pupils. This I consider a great gain. The saving in attention to the heating apparatus, and from the annoyance from over-heating and under-heating, amply repay the cost of your apparatus.

GEO. W. PECKHAM,
Principal.

From Principal Ninth Ward Public School.

Milwaukee, January 19, 1886.

Gentlemen: Your Heat Regulating Apparatus has proved to be an entire success in our school building. It works well, easily, without any trouble, and has not failed yet since its introduction. We are highly pleased with it, and I recommend it in good faith. I would like to say more in favor of this Apparatus, but I am confined to my bed. Yours truly,

LOUIS HILLMANTEL.

From Principal Tenth District School, Milwaukee.

Gentlemen: It is with pleasure that I certify to the merits and effectiveness of the "Electric Service" as applied to regulating the temperature of our school rooms. I never imagined that the Apparatus could be so perfect, or that it would so fully meet the requirements; but after four months of trial, with the thermometer varying from 40° above to 20° below, our 20 class rooms, 2 offices, large exhibition hall, 22 teachers, and 1,200 pupils were all *comfortably* warmed—the first time since I have been teaching. The even temperature has been conducive to the health of pupils and teachers.

I therefore pronounce the Heat Regulating Apparatus an unqualified success, and take pleasure in recommending it to all principals and school officers for introduction in the various school houses. I trust that the public in general will not be slow in making use of this reliable health-giving and fuel-saving Heat Regulating Apparatus. Very truly yours, JOHN A. DIEDRICHSEN,

Principal Tenth District School, Milwaukee, Wis.

Milwaukee, April 26th, 1887.

Gentlemen: The Johnson Heat Regulating Apparatus is in use in six school rooms and two offices in our school. It has proved itself reliable and satisfactory as a means of regulating the amount of heat admitted to the rooms. While there is yet something to be done to control the amount of cold air directly admitted to the rooms where the apparatus is in use, in order to secure the full comfort of teachers and pupils, I am satisfied that as far as the responsibility of the Heat Regulating Apparatus is concerned, there is no fault to find. The ventilation of the rooms where the Heat Regulating Apparatus is in use seems to be perfect, while in the other nine rooms of the building it is far from perfect.

I believe the Johnson Apparatus is conducive to health, mental vigor, and sweet good nature.

Very respectfully, LEWIS FUNK,

Principal Seventh District School.

Milwaukee, Wis., April 26, 1887.

Gentlemen: Your Heat Regulating Apparatus has been in use in this building for one year, so I have had ample time to test it in all kinds of weather. I am pleased to say that it never allows the rooms to be overheated. It takes care of the valves on the steam heating apparatus, so that our teachers never have to give attention to the matter of regulation of heat. So far it does this work properly.

KATE C. McCABE,

Principal Twelfth District Primary School.

MENOMONIE SCHOOLS.

Menomonie, Wis., March 3, 1887.

Gentlemen: We have nothing but words of approval for the Apparatus. It does its work perfectly, and without any fuss or trouble. It has not been touched nor interfered with in any manner since it was placed in operation. Since it has been in, we have not had to open a single window in any one of the ten large rooms to which it is attached, a thing which has not happened, prior to this, during my eleven years work here. While we in this building are sitting in comfort with closed windows, those in the other buildings are compelled, several times daily, to throw open the windows, and suffer all the inconveniences of such a system of reducing the temperature of an overheated room.

Our janitor claims, *and with the proofs before him*, that he does not use quite two thirds the fuel formerly used. Very truly yours, JOHN G. INGALLS,

Principal City Schools, Menomonie, Wis.

HYDE PARK SCHOOLS.

REPORT OF TEMPERATURE.

	Monday.	Tuesday.	Wednesd'y	Thursday.	Friday.
8:45 A.M.	70	73*	73	70	70
10 "	70	73	72	70	70
11 "	71	73	70*	71	69
12 M.	70	73	70	70	70
1:15 P.M.	70	73	70	70	70
2 "	70	72	72	70	70
3 "	71				
4 "					

L. A. Davis Teacher.

Jan 21 * Changed the thermostat 1887

REPORT OF TEMPERATURE.

	Monday.	Tuesday.	Wednesd'y	Thursday.	Friday.
8:45 A.M.	70	70	70	70	70
10 "	70	70	70	72	70
11 "	70	70	70	70	70
12 M.	70	70	70	70	70
1:15 P.M.	70	70	70	70	70
2 "	70	70	70	70	70
3 "	70	70	70	70	70
4 "	70	70	70	70	70

Belle B. MacCartney Teacher.

January 17-21, 1887.

REPORT OF TEMPERATURE.

	Monday.	Tuesday.	Wednesd'y	Thursday.	Friday.
8:45 A.M.	70	70	70	70	70
10 "	70	70	70	70	70
11 "	70	70	70	70	70
12 M.	70	70	70	70	70
1:15 P.M.	70	70	70	70	70
2 "	70	70	70	70	70
3 "	70	70	70	70	70
4 "	70	70	70	70	70

Lenora Root Teacher.

March 28-April 1st 1887

REPORT OF TEMPERATURE.

	Monday.	Tuesday.	Wednesd'y	Thursday.	Friday.
8:45 A.M.	70	72	70	70	70
10 "	71	72	76	70	70
11 "	70	70	70	71	71
12 M.	72	70	70	71	70
1:15 P.M.	71	70	70	71	70
2 "	70	70	70	70	70
3 "					
4 "					

Main room

W. A. Reed Teacher.

1-21 1887.

The above are *fac-simile* engravings of report cards taken in the Hyde Park High School at the dates named. They need little explanation. It will be seen that the teachers were required to give hourly reports of the temperature of the various rooms. These cards are no better than dozens of others which we might have reproduced. It will be observed that in Miss McCartney's room the thermometer did not vary but once from 70° during the week. On Thursday at 10 A. M. It stood at 72. In Miss Root's room it fell below 70 but once; at 3 P. M. March 29, it fell to 68°. In the main or assembly room during the week shown, the extreme variation was two degrees. In none of the four rooms was the *variation greater than two degrees*, excepting in one room where the variation was caused as indicated by changing the adjustment of the thermostat. We would say that we knew nothing about these records being taken. Many like them may be seen at Hyde Park.

HYDE PARK SCHOOLS.

Hyde Park, Ill., March 5, 1887.

Gentlemen: It gives me pleasure to comply with your request for a statement of our experience with your Automatic Heat Regulator. We have thoroughly tested the Apparatus in the new High School for this district for more than six months, with the following result:

1st. The temperature is practically invariable; e. g., in the ten rooms during one week of the coldest weather, an observation of the temperature was taken and recorded once an hour for five days, with a result of variation of less than three degrees in any room.

2d. A considerable saving in care to teachers constantly watching the temperature.

3d. A great gain in the hygienic condition of the rooms, due to the equable temperature.

4th. A large economy in fuel.

These facts are sufficient to satisfy me that the Automatic Apparatus is most desirable in every school building, and to justify me in recommending it to all school officers.

Yours very truly, W. H. RAY,
Principal.

Hyde Park, Ill., April 12, 1887.

Gentlemen: The Electric Apparatus which you put into our High School building, for the purpose of regulating the temperature in the different rooms, is doing all that it was expected to do.

After it was once properly adjusted, it shut off the hot air as soon as the temperature reached 70 degrees, and immediately opened the valves and admitted the warm air when the temperature went below 70 degrees. It is better than any human agency, since it is not negligent and does not get tired. It requires little or no care, is quickly adjusted to any temperature required, and does not easily get out of order.

Yours truly, LESLIE LEWIS,
Superintendent of Schools.

JOSHUA BATES SCHOOL, BOSTON.

From *The Sanitary Engineer* of May 6, 1886, we take pleasure in reproducing the following clipping from an article descriptive of the Joshua Bates School, Boston. The article has reference to the architecture, furnishing, ventilating and heating of the building. To indicate that the writer was entirely disinterested in regard to his tests of our Apparatus, we would say that who he is we do not know, and, moreover, that we did not know of the article having appeared in *The Sanitary Engineer* until some months afterward, when our attention was called to it by some correspondent. The paragraph in regard to the heating is as follows. (The italics are ours):

"The temperature of the rooms varied from 67 to 82 degrees. In one of the rooms a damper for allowing the fresh air to enter the room without passing through the radiators was placed in the box. This damper was regulated to open automatically when the temperature of the room reaches 68 degrees, by an arrangement supplied by the Johnson Electric Service Company. Another room was provided with the Johnson Electric valves, which shut off the steam when the temperature of the room reaches 68 degrees, and lets it on again when the mercury falls below that point. Both these valves and the damper are worked by an automatic apparatus, depending upon electricity, compressed air, and the principle of the the thermostat. *The temperature in these two rooms did not exceed 69 degrees.* In the other rooms *the temperature varied from 68 to 82 degrees,* the average of the six rooms *being 74 1-2 degrees.* The pressure of the steam in the boiler varied from six to ten pounds." (*The Sanitary Engineer, May 6, 1886.*)

FROM THE WAUKESHA SCHOOLS.

WAUKESHA, Wis., April 1, 1887.

GENTLEMEN: It is always a pleasure to recommend a good thing. Your apparatus for regulating temperature has been in use in twelve rooms of our school building since last September. To say that we are greatly pleased with it would be a very mild statement. There are three reasons why we would not be without it, any one of which is sufficient.

1st. *Comfort.* Our rooms are just warm enough, never too warm; and there are no draughts from windows opened to cool the room.

2d. *Convenience.* The teacher does not have to think of temperature from morning to night, and can give her undivided attention to her work, without being interrupted every few minutes by the room getting too warm or too cold.

3d. *Economy.* It is costing us 16⅔ per cent. less to heat the same space in our building this year than last, and it is better done. This is a surprise to us; for we have thoroughly ventilated the building, and from the best estimate we could make we concluded that it would cost us at least 25 per cent. more to heat it than before. We attribute this largely to your Apparatus.

It is one of the most valuable appliances ever put into a school building.

Very truly yours, G. H. REED, Principal.

WAUKESHA, Wis., April 2, 1887.

GENTLEMEN: I have been on our school board here for the past fifteen years; have studied the heating and ventilating question earnestly. Last year, in enlarging and greatly improving our old building, we introduced the Ruttan system of heating and ventilation, at the same time introducing into 12 rooms your Apparatus for regulating the same.

I will simply say, for purity of atmosphere in all of the rooms, even temperature and economy of fuel, this system strikes us as being as near to perfection as anything can be, which result is largely due to your Heat Regulating Apparatus. It never tires nor stops its use. The janitor in the basement is automatically apprised whether each room is at the required temperature or not, and can regulate his fires accordingly. We cheerfully invite inspection. Very truly yours, A. J. FRAME,

Treasurer School Board, President Waukesha National Bank.

COUNCIL BLUFFS SCHOOLS.

COUNCIL BLUFFS, Ia., January 19, 1887.

GENTLEMEN: We desire to express to you the unqualified satisfaction which the JOHNSON HEAT REGULATING APPARATUS, placed by you in our Pierce Street School, is giving.

The heating apparatus in this school in preceding years has failed to heat the building well. The changes which you recommend in connection with the Apparatus, in combination with the JOHNSON System, has enabled us to heat the building completely. The temperature has been perfectly controlled to a uniform standard in all the rooms during this severe winter, and a considerable economy in fuel has already been secured, as compared with previous years. The recommendations which you have given in regard to other heating plants in our schools have proved valuable to our board, and the good results have been attained at a very moderate expenditure of money. In view of these facts, we desire you to submit proposals that shall cover the application of the JOHNSON HEAT REGULATING appliances to other buildings under our charge that are heated by steam or the Ruttan system.

R. T. BRYANT,
J. R. BELL, } Committee on Heating, etc.

J. B. ATKINS, President Board.

COUNCIL BLUFFS, Ia., April 6, 1887.

GENTLEMEN: I take pleasure in stating that the JOHNSON HEAT REGULATING APPARATUS, in the matter of regulating the temperature of our school rooms, in connection with the steam and hot air systems, works to our entire satisfaction. Respectfully yours,

JAS. McNAUGHTON,
Superintendent of Schools.

NEW YORK CITY SCHOOLS.

GRAMMAR SCHOOL No. 68,
116 West 128th Street,
NEW YORK, April, 1887.

GENTLEMEN: In accordance with a request from the Board of Trustees of the Twelfth Ward, the two rooms that were the most difficult to keep at an even temperature, and in which the teachers and pupils suffered greatly from excessive heat during the winter, were selected to test your Heat Regulating Apparatus.

The usual range of the thermometer was from 74 to 84 degrees. Since the introduction of your Apparatus the temperature has varied so slightly from the figures at which the thermostat was set (70 deg.), that it could not be detected by sensation, but only by closely watching the thermometer, and what you claimed for it has been accomplished, and we hope the Board will see fit to put it in every room in this department.

JULIET PEARSON, Principal.
CARRIE E. HIGHET, Class Teacher.
KATE L. BOGART, Class Teacher.

THE JOHNSON HEAT REGULATING APPARATUS is already in use, or has been specified, for the following schools, at the date of this writing, and others are falling into line constantly.

NEW YORK.
Grammar School No. 68.
(Two Rooms.)

BOSTON.
Joshua Bates School.
(Two Rooms.)

CHICAGO.
Froebel School.
Grant School.

HYDE PARK.
High School.

WAUKESHA, WIS.
Union School.

MILWAUKEE.
New High School.
1st District Primary.
7th District Addition.
8th District Branch.
9th District.
10th District.
11th District.
12th District Primary.

WOODLAWN, ILL.
High School.

ELKHORN, WIS.
High School.

ST. PAUL, MINN.
Jefferson School.
Madison School.
Lincoln School.

COUNCIL BLUFFS.
Bloomer St. School.
Pierce St. School.

ROCK ISLAND.
High School.

BELOIT, WIS.
Ward School.

MENOMONIE, WIS.
High School.